

# **A quick overview of the benefits from initialization of the EC-Earth forecast system:**

## **comparison between yearly decadal hindcasts and historical simulations**

Virginie Guemas

In collaboration with:

Francisco Doblas-Reyes, Isabel Andreu-Burillo, Muhammad Asif, Hui Du

## Our focus : Seasonal to decadal prediction

 **Francisco J Doblas-Reyes : The Head**

 **Isabel Andreu-Burillo: *air-sea dynamics***

 **Alberto Carrassi: *initialisation techniques***

 **Virginie Guemas : *Sea ice, North Pacific skill***

 **Fabian Lienert : *regionalisation, PDO***

 **Melanie Davis : *climate services***

 **Danila Volpi : *initialisation techniques, DePreSys***

 **Luis Ricardo Rodrigues : *ENSO, statistical models***

 **Aida Pintó : *extremes***

 **Muhammad Asif : *EC-Earth***

 **Oriol Mula-Valls : *system administrator***

 **Domingo Manubens : *autosubmit developer***

We share, on request :

- 1) Autosubmit
- 2) Our decadal hindcasts
- 3) Monthly sea ice restarts
- 4) R diagnostic functions

We run on :

- 1) Marenostrum ( Spain )
- 2) ECMWF
- 3) Lindgren ( Sweden )
- 4) HECTOR ( Scotland )
- 5) Our local cluster

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system:**

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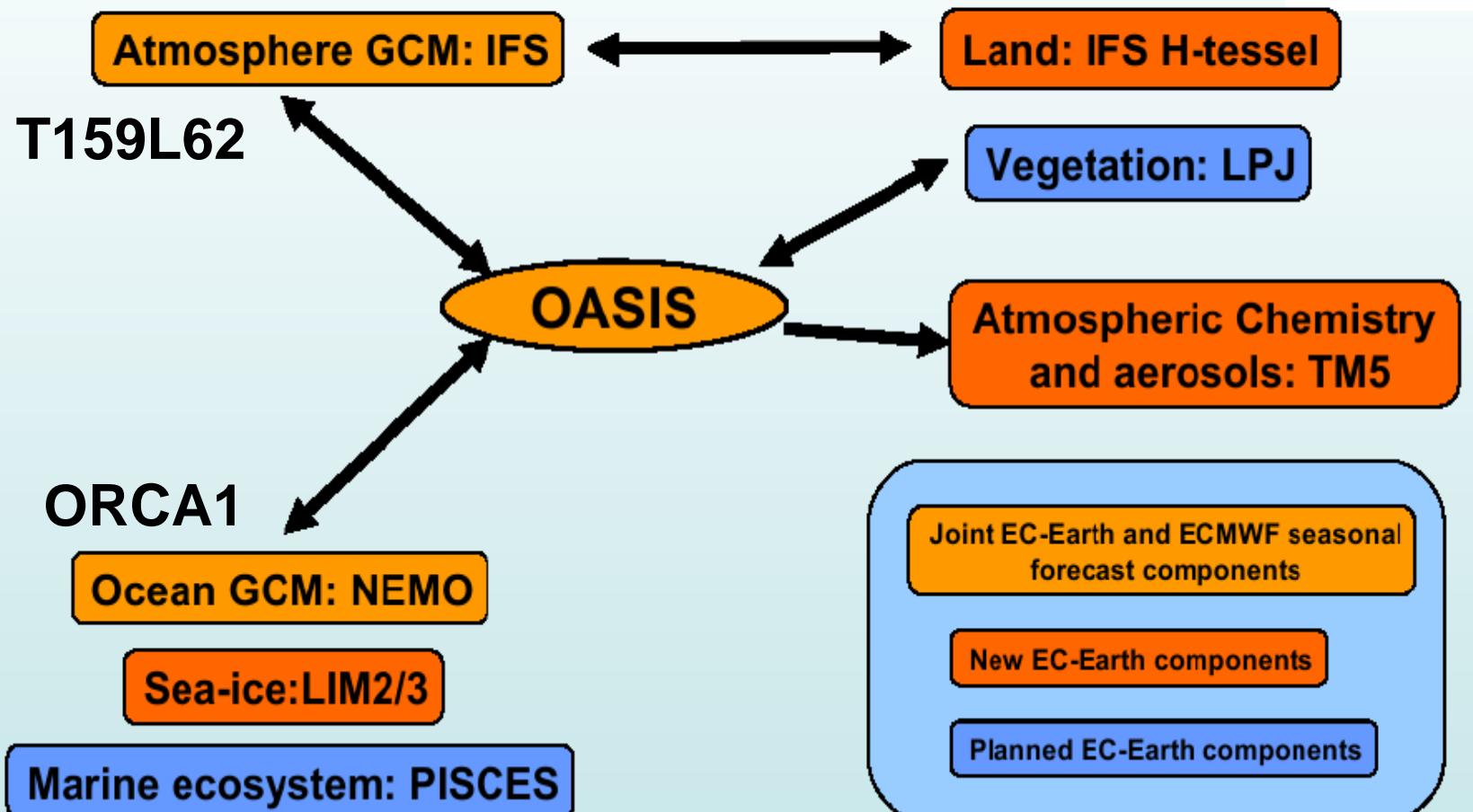
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## Which tool ? EC-Earth v2.3

# EC-EARTH components

(Hazeleger et al, 2010)



## Which experimental design?

A – Yearly hindcasts – 5 members – 10 year long : ➡ **Init**

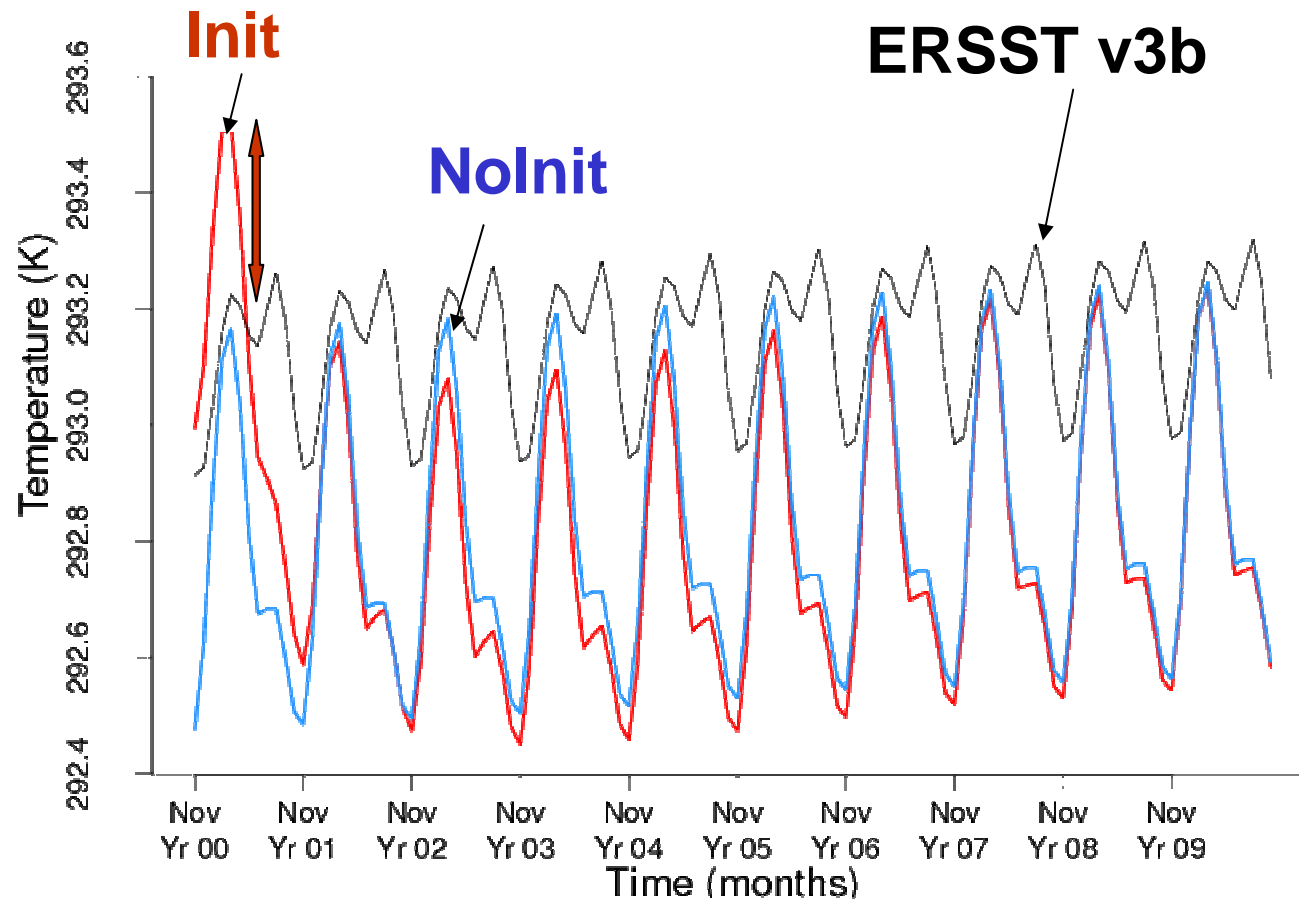
- Ocean initialized from the 5 members of NEMOVAR-S4 (Mogensen et al 2012)
- Atmosphere initialized from ERA40 / ERA interim, perturbation singular vectors
- Sea ice initialized from an NEMO2/LIM2 simulation forced with DFS4

### FULL FIELD INITIALIZATION

B - Historical simulation – 3 members – 1950-2025 ➡ **NoInit**

# Global Sea Surface Temperature (60S-65N)

Climatology

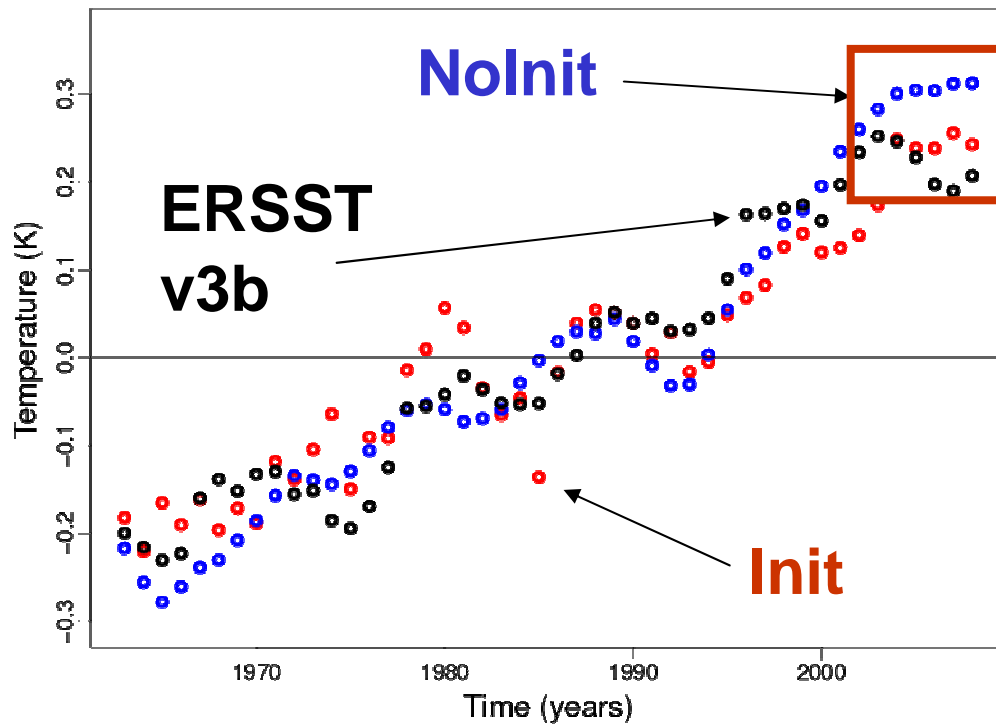


➡ Initial warming : 0.3K, then after 2<sup>nd</sup> year, Init cooler than Nolnit

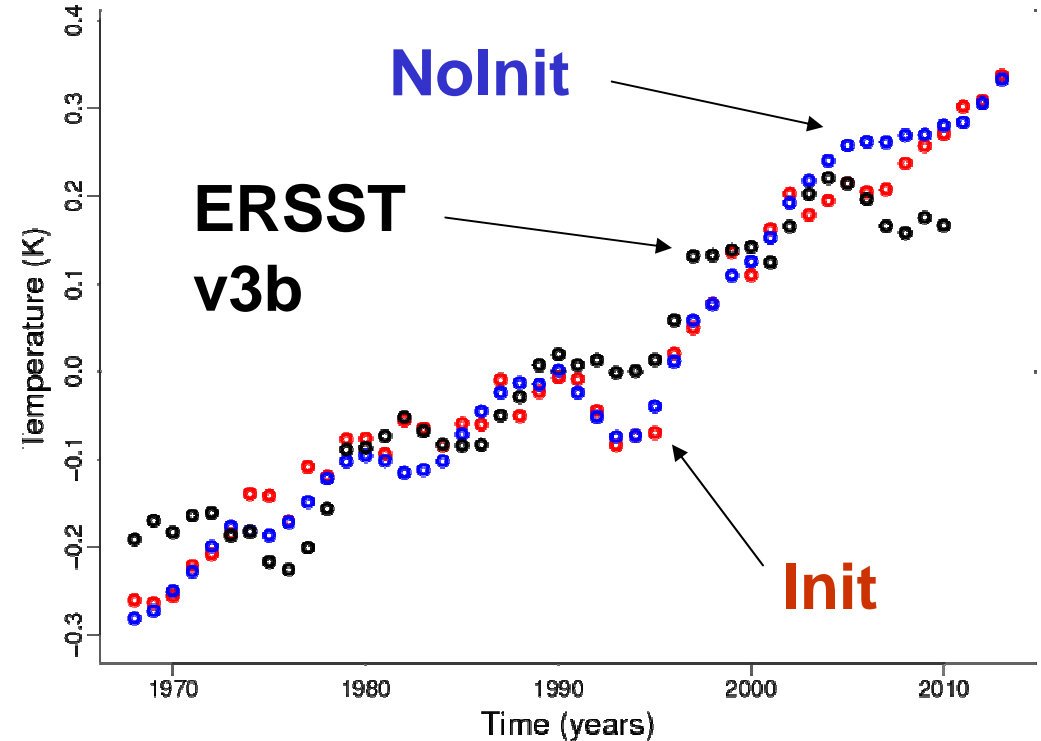
# Global Sea Surface Temperature (60S-65N)

## Anomalies

Forecast times : 2 - 5 years



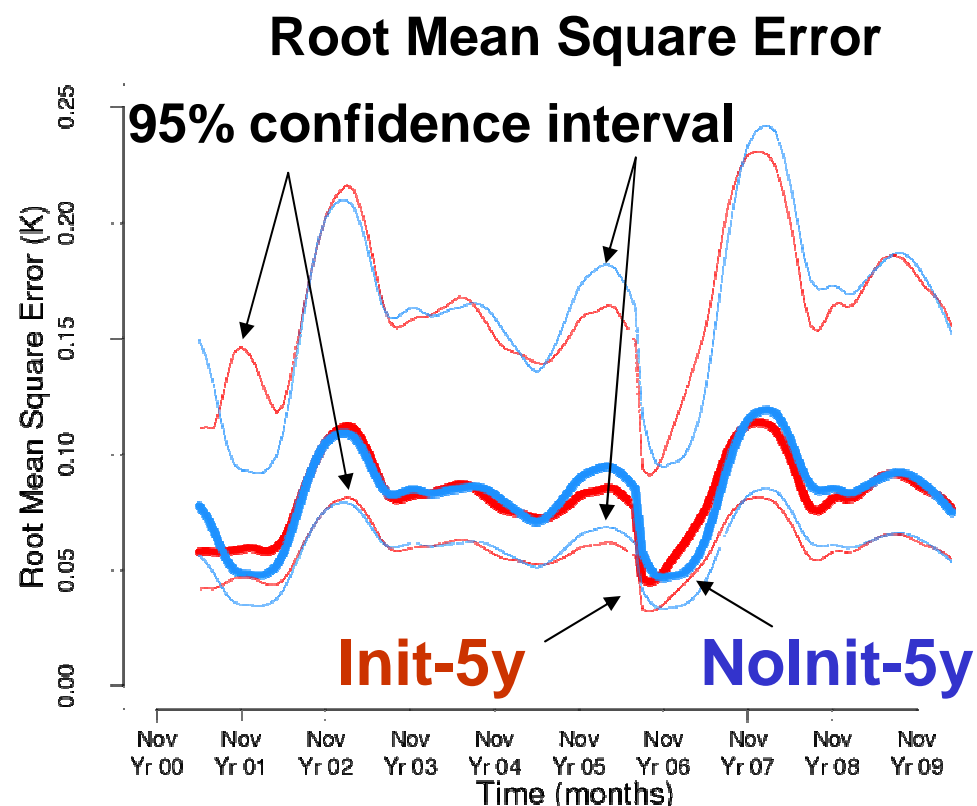
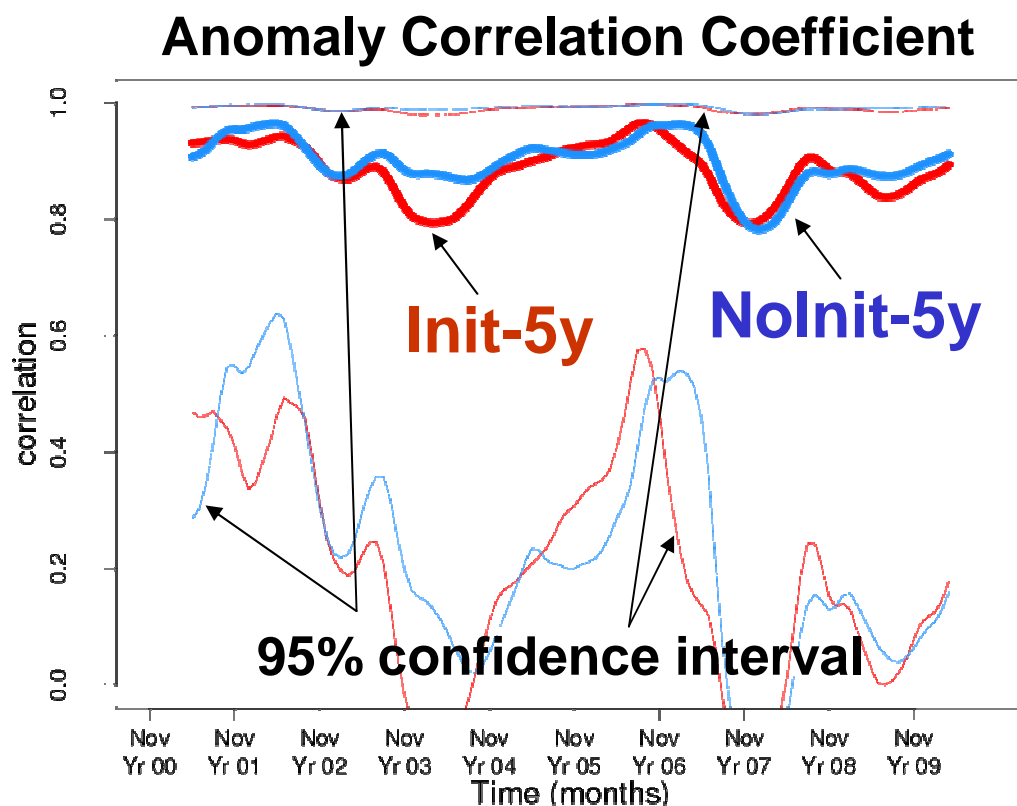
Forecast times : 6 - 9 years



- ➡ Benefits from initialization in the last decade – ARGO profiles
- ➡ Init tends to converge toward NoInit for forecast times 6-9 years

# Global Sea Surface Temperature (60S-65N)

If we use 5-year hindcasts (=CMIP5 setup):

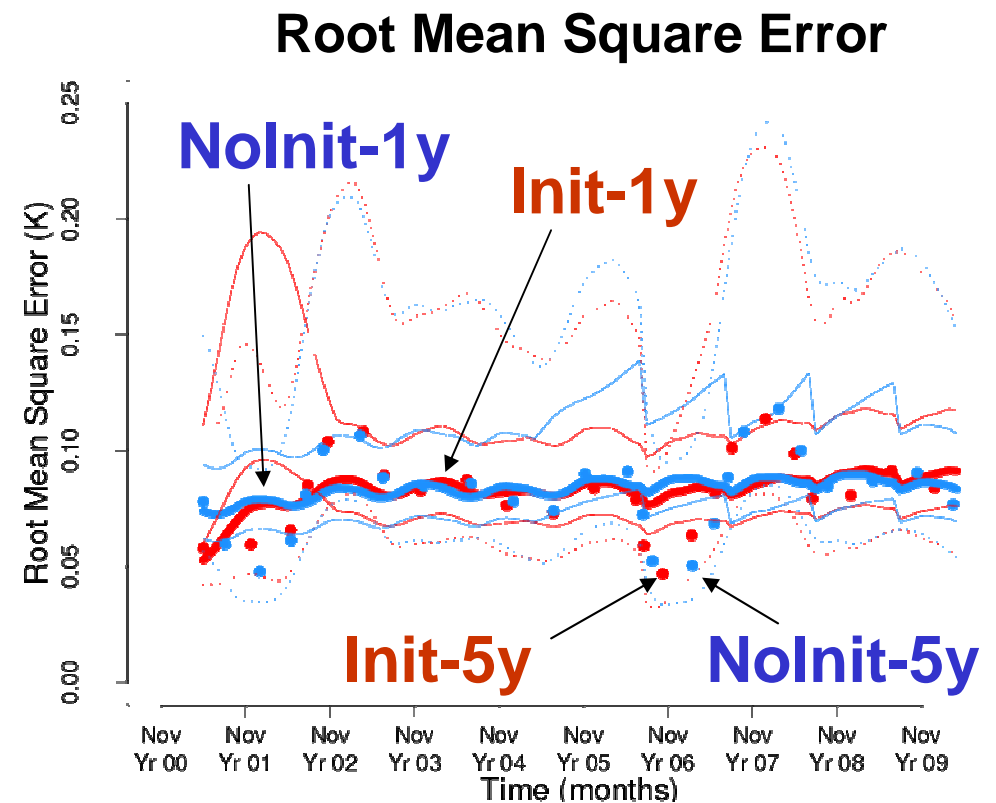
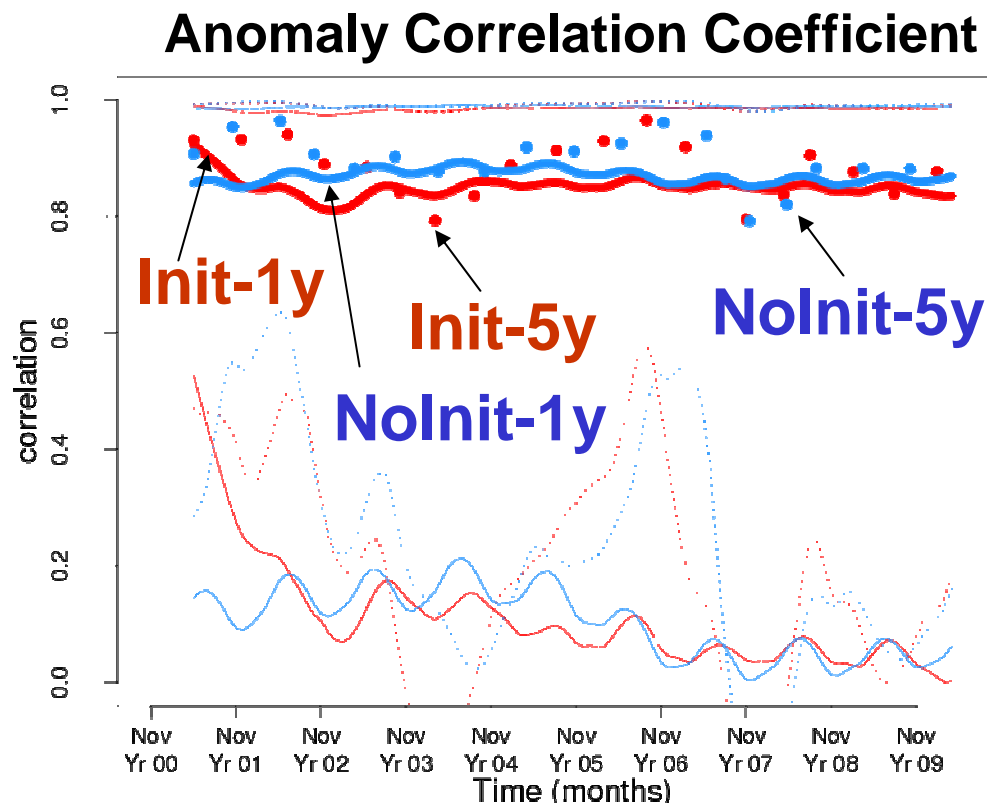


➡ Noisy scores, benefit from initialisation barely distinguishable



# Global Sea Surface Temperature (60S-65N)

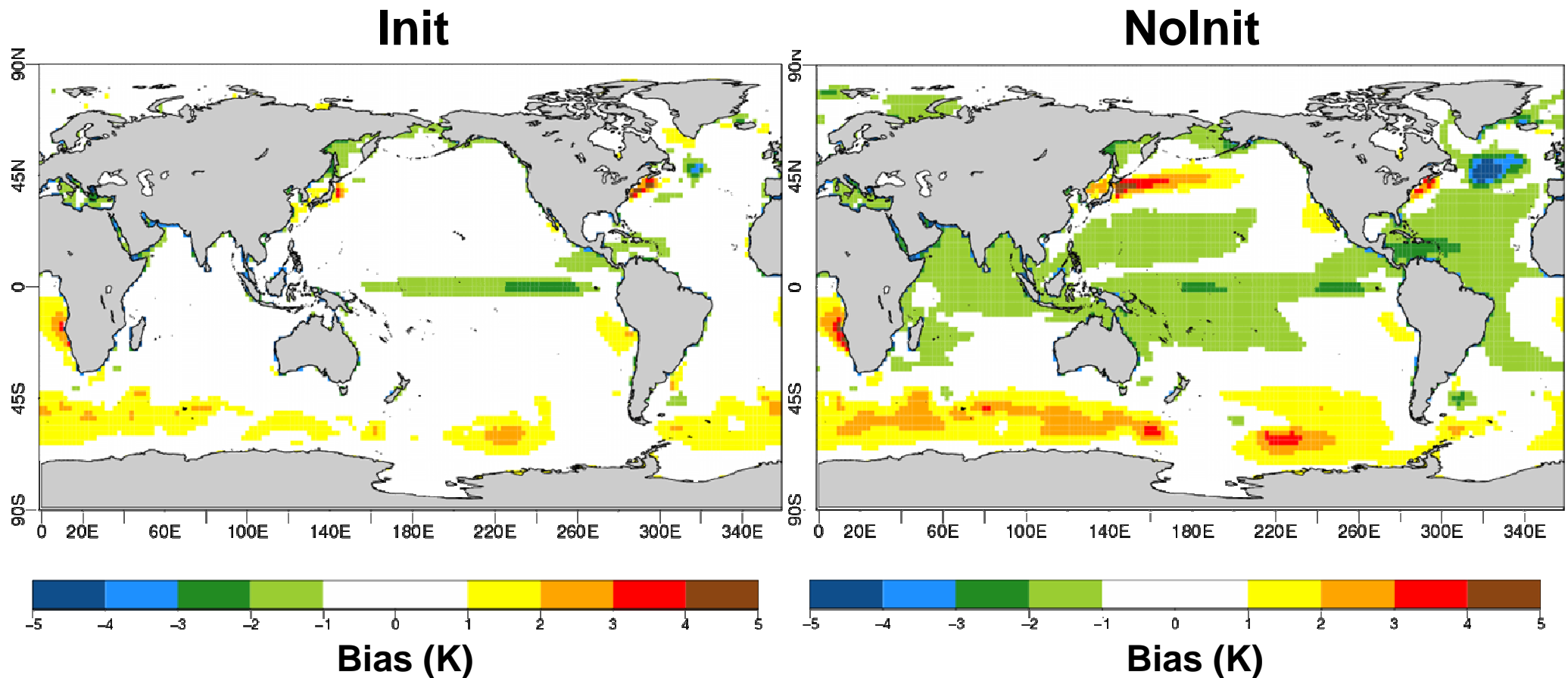
If we use yearly hindcasts:



➡ With yearly hindcasts, it becomes possible to detect a benefit from the initialisation during the first year

# Sea Surface Temperature **bias** - yearly hindcasts

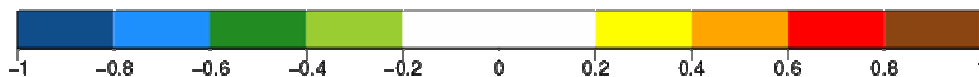
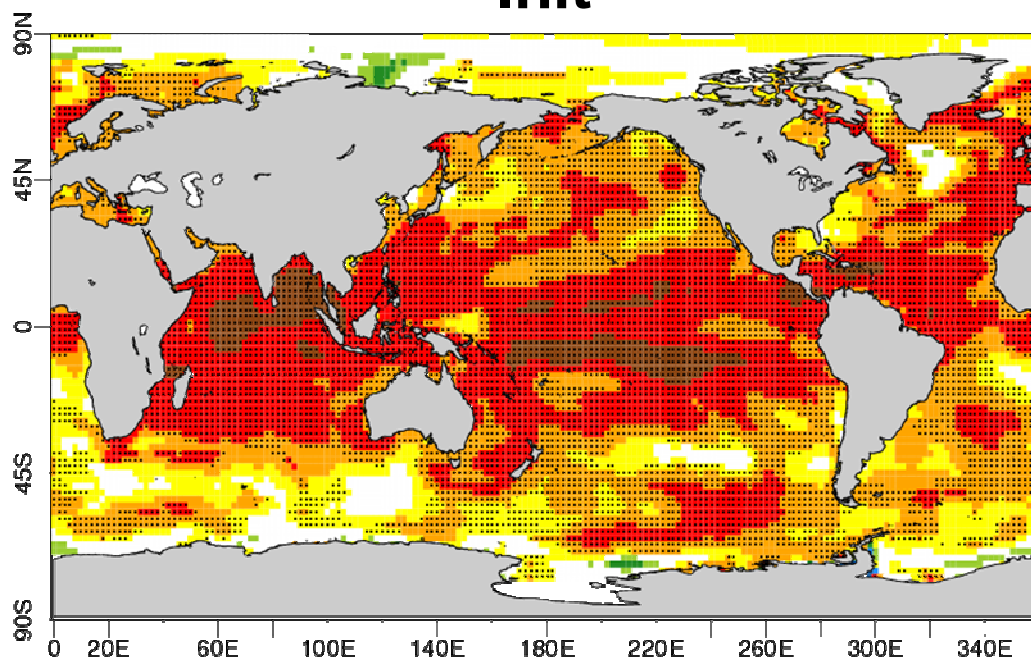
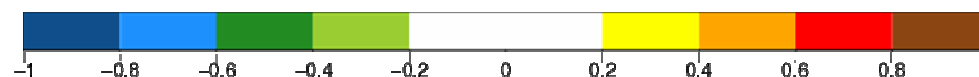
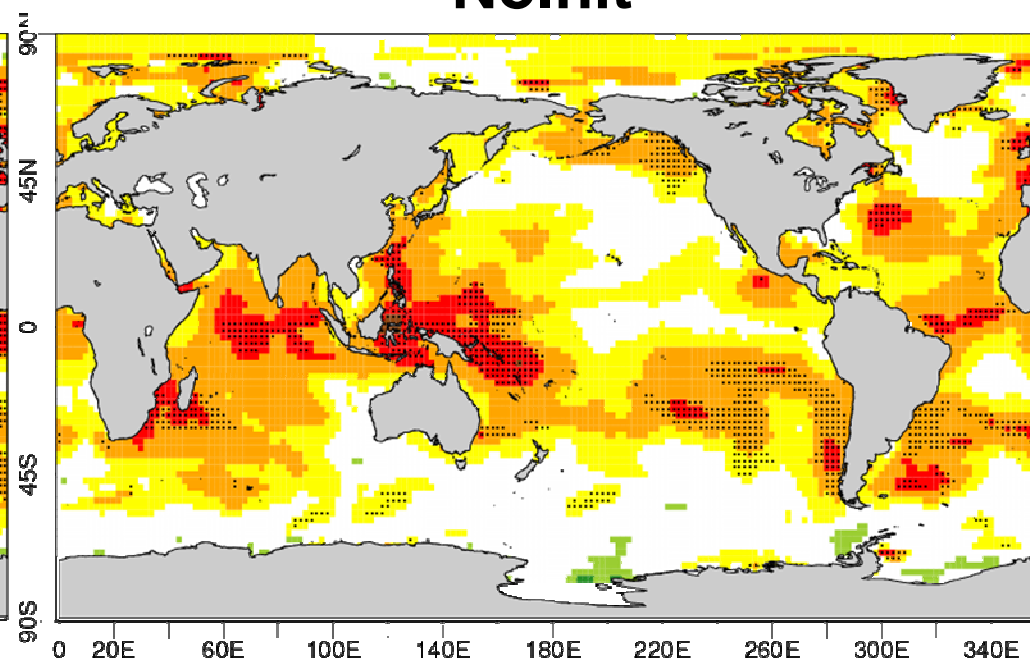
## Forecast time : 1<sup>st</sup> year



➡ Early development of the warm Austral bias

# Sea Surface Temperature ACC – yearly hindcasts

## Forecast time : 1<sup>st</sup> year

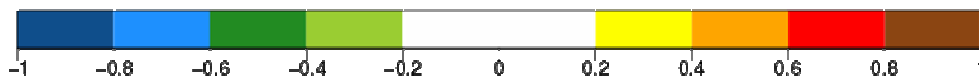
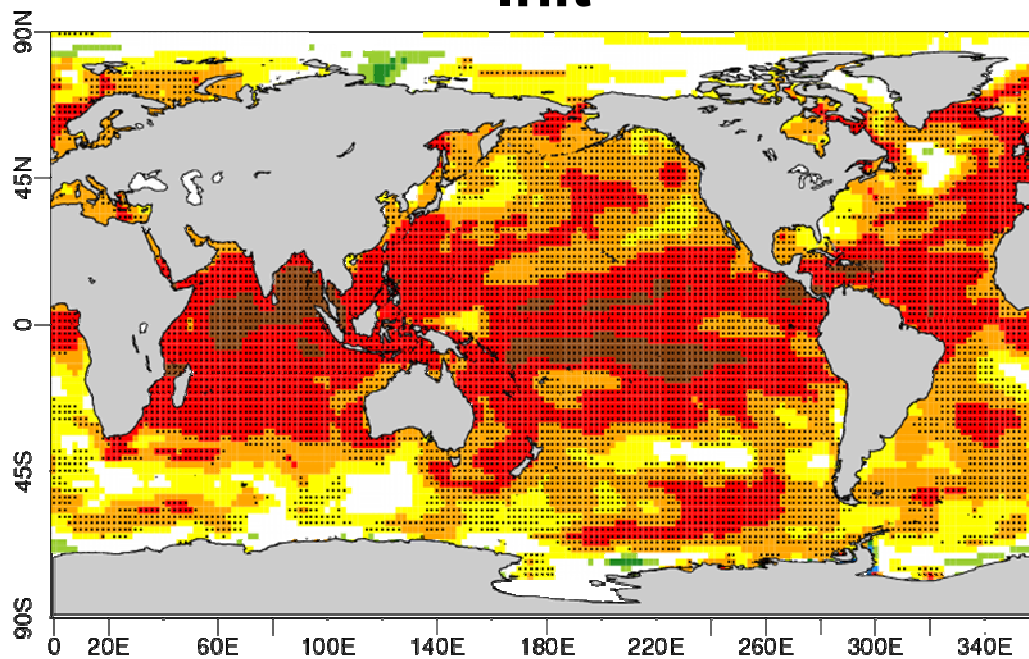
**Init****Correlation****Nolnit****Correlation**

**Black dots indicate ACC reaching the 95% significance level**

# Sea Surface Temperature ACC – yearly hindcasts

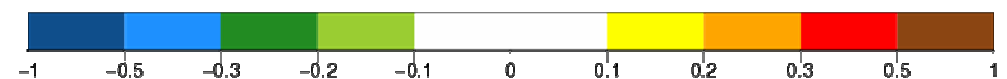
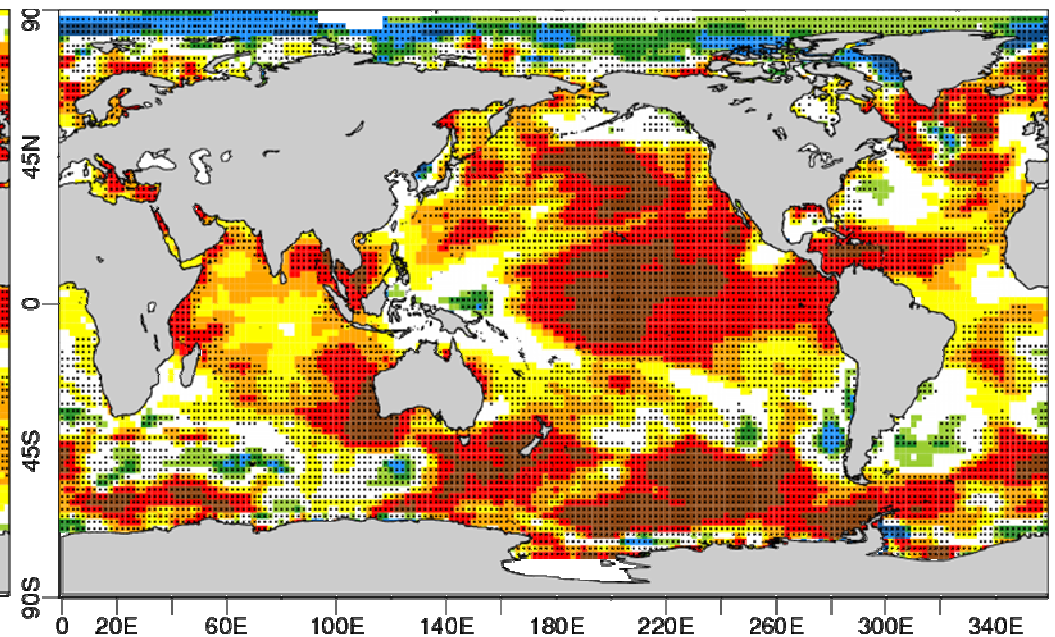
## Forecast time : 1<sup>st</sup> year

Init



Correlation

Init-NoInit



Difference in correlation

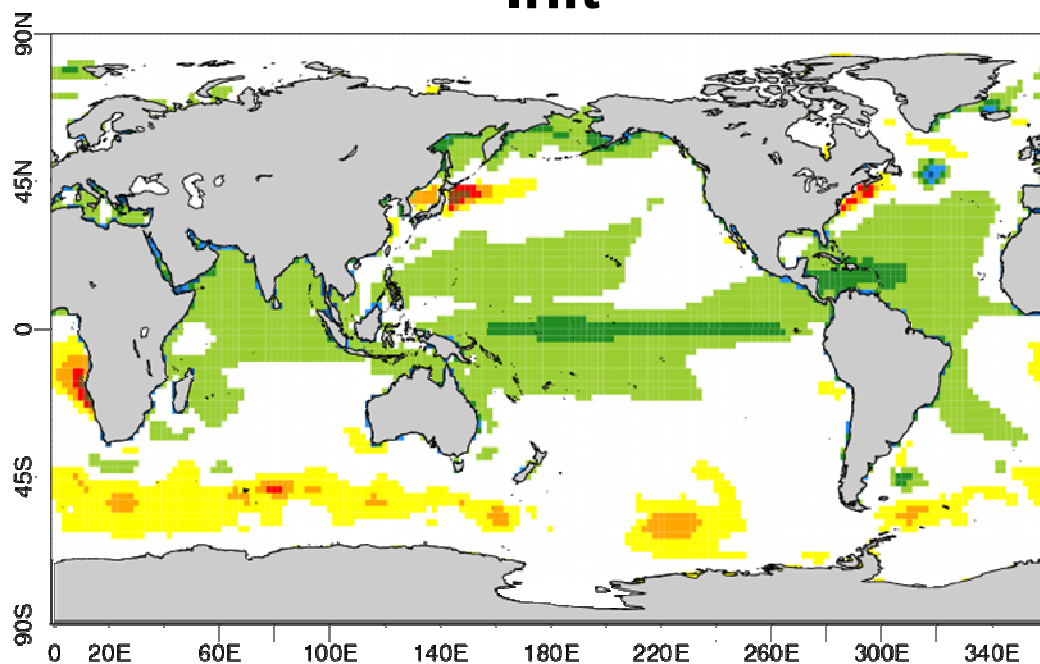
➡ Clear benefits from initialization, major role of the ENSO



# Sea Surface Temperature **bias** - yearly hindcasts

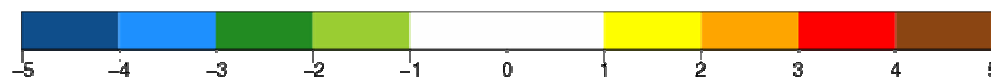
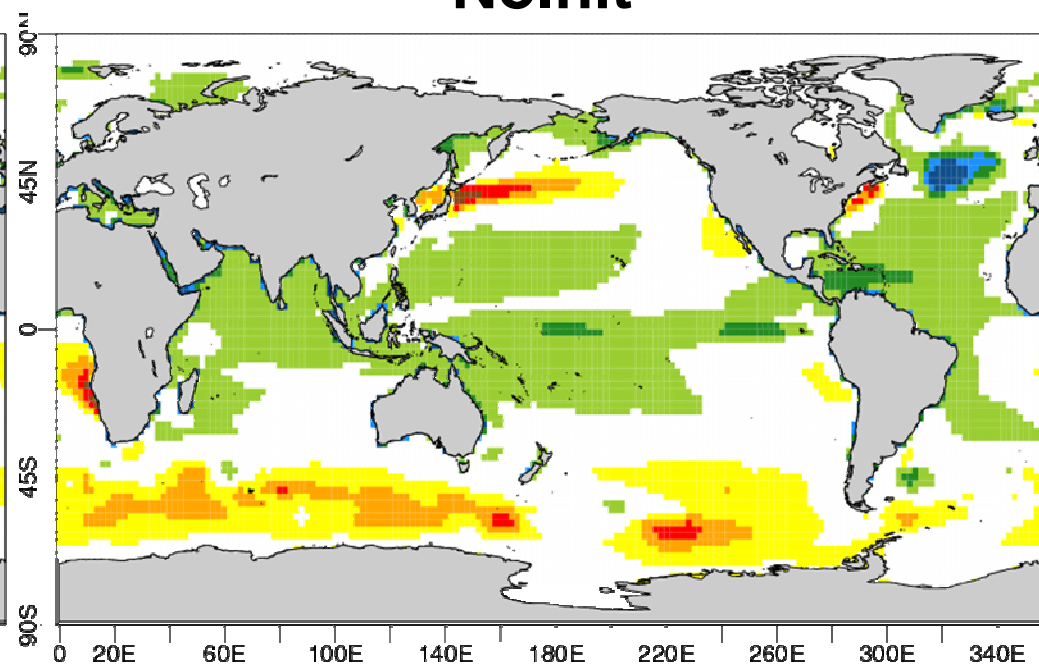
## Forecast time : 2-5 years

Init



Bias (K)

Nolnit



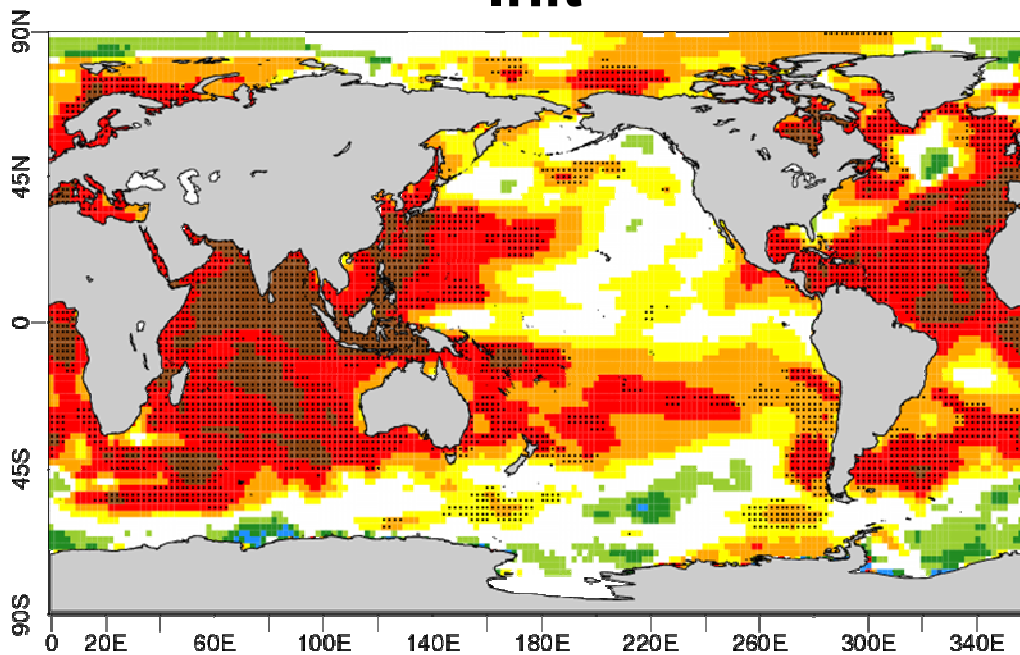
Bias (K)

➡ Tropical band cooler in Init than Nolnit

# Sea Surface Temperature ACC – yearly hindcasts

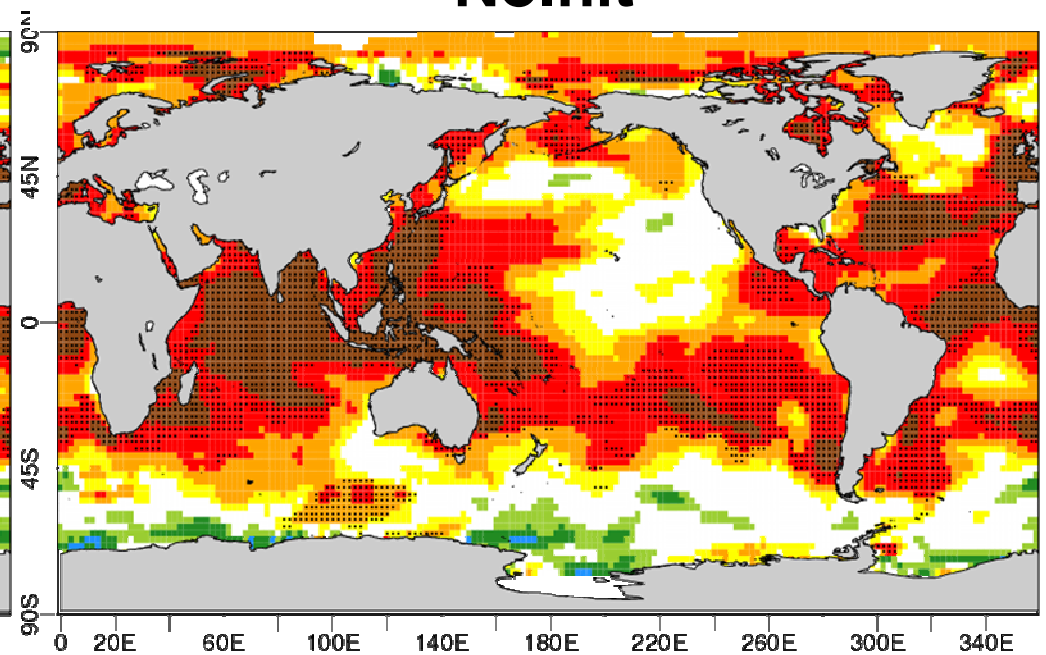
## Forecast time : 2-5 years

Init



Correlation

Nolnit



Correlation

Black dots indicate ACC reaching the 95% significance level